OASIS ENVIRONMENTAL, INC.
LAKE LUCILLE AND BIG LAKE
WATER QUALITY MONITORING

Quality Assurance Project Plan

May 2004

A. Project Management Elements

A1. Title Page and Approvals

Project Manager	**Date**
Quality Assurance Officer	**Date**
ADEC Project Manager	**Date**
ADEC Water Quality Assurance Officer	**Date**

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A2. Table of Contents

Tables

Figures

Attachments

A3. Distribution List

This list includes the names and addresses of those who receive copies of this approved QAPP and subsequent revisions. It is not the list of those who receive data reports.

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A4. Project/Task Organization

OASIS Environmental, Inc. (OASIS) has been contracted to monitor lake water quality on two lakes in the Matanuska Susitna Borough, Lake Lucille and Big Lake, for nutrients, bacteria, hydrocarbons and additional field parameters. Tasks to be performed include sampling in May and June and reporting results in a final report to be submitted July 30, 2004. Staff duties and responsibilities for completing these tasks are described below.

OASIS staff

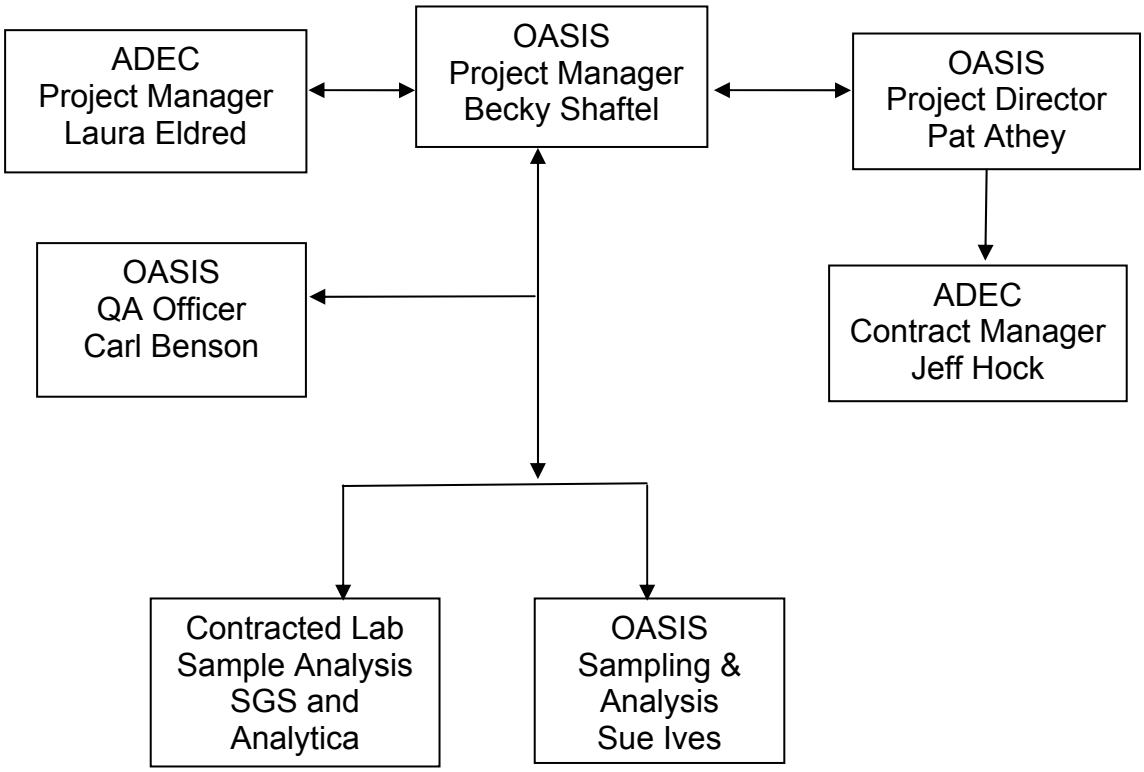
- Pat Athey is the Project Director. He will provide overall senior review and direction for the project.
- Becky Shaftel is the Project Manager for OASIS. She will coordinate tasks and deliverables for the project and serve as the primary point of contact for communications with ADEC project staff. She will contribute to sampling throughout the summer and interpretation and reporting of data.
- Carl Benson is the Quality Assurance Officer. He will be responsible for QA/QC of all data.
- Sue Ives will provide support as an Environmental Scientist. She will assist in collecting samples throughout the summer and help in reporting responsibilities.

Two laboratories will be used for this project. The main project laboratory performing all of the analyses except for chlorophyll a, will be SGS Environmental Services (SGS). Shane Poston will be the contact for this project. Analytica Alaska, Inc. (Analytica) will analyze the chlorophyll a samples. Wendy Mitchell will be the contact for these samples.

ADEC Staff

- ADEC Project Manager is Laura Eldred. Laura will be the primary contact for technical questions or other questions related to the project.
- ADEC Contract Manager is Jeff Hock.
- ADEC Quality Assurance Officer is Kent Patrick-Riley. He will assist in development of the QAPP, if necessary, and approve it for ADEC along with the ADEC Project Manager. He may also review data and/or audit monitoring activities.

Organization Chart



A5. Problem Definition/Background

The purpose of this project is to conduct an initial water quality assessment of Lake Lucille and Big Lake for nutrients, dissolved oxygen, bacteria, hydrocarbons and other field parameters.

Prior limnological studies have been conducted on both lakes. A Total Maximum Daily Load (TMDL) for Lake Lucille was completed in 2002 for dissolved oxygen based on previous water quality studies. Phosphorus concentrations in the lake increase the growth of aquatic vegetation, which, during decomposition, depresses dissolved oxygen levels in the lake. Sources of phosphorus to the lake include historic septic systems, wildlife and pet waste and urban runoff from lawn fertilizers. A detailed study on the limnology of Big Lake was conducted in 1983-84. Nutrient results indicated that the lake was oligotrophic, but dissolved oxygen levels were low during summer stratification and under winter ice cover. Shoreline development at Big Lake may also be contributing nutrients to the lake that are increasing aquatic growth and lowering dissolved oxygen levels. Other contaminants of concern at both lakes include hydrocarbons from motorized recreation and bacteria from human and animal waste.

This sampling program includes sites selected based on activities in the area contributing to the parameters of concern: nutrients, dissolved oxygen, bacteria,

hydrocarbons and other field parameters. Background sites, historic sampling sites and areas with receptor organisms such as swimming areas or sensitive habitat areas will also be included in the site selection. Activities that may contribute to the parameters of concern include boat, plane and small watercraft traffic, maintenance and fueling areas, boat launches and marinas, septic systems, docks, subdivisions, animal waste, fertilizers, fish carcasses, etc. Three sampling events are scheduled to occur in May and June. The first sampling event in May is scheduled after the ice has broken and before the spring turnover when the upper surface layer of water reaches 39° C (maximum density), sinks and mixes the water column. The second and third sampling events on May 29/30 (Memorial Day weekend) and June 12/13 are scheduled to target high recreational use on weekends. Final data results will be analyzed by comparing water quality parameters with Alaska Water Quality Standards (AWQS) and evaluating the temporal and spatial extent of their impact.

A6. Project/Task Description

The proposed work elements to meet the project objective are summarized below by task. Each task summary includes the products to be produced and delivered for that task and the task schedule.

Develop Sampling Plans

Sampling plans for each lake will be developed in draft form and finalized upon receipt of comments from ADEC.

Deliverable: Big Lake Sampling Plan and Lake Lucille Sampling Plan

Schedule: completed by May 5, 2004

Quality Assurance Project Plan

This QAPP will be submitted for approval by ADEC prior to collection of samples.

Deliverable: QAPP

Schedule: completed by May 5, 2004

Field Data Collection

Data will be collected during three sampling events in May and June to monitor water quality on the lakes for parameters of concern: nutrients, dissolved oxygen, bacteria and hydrocarbons. For a complete list of parameters to be measured, see Table 1 in Section A7. On Big Lake, fourteen sampling sites will be selected for each group of parameters except for nutrients, which will only have six sampling sites. On Lake Lucille, four sampling sites will be selected for each group of parameters. A detailed description of the sampling program is provided in Section B1, Sampling Process Design. Table 2 in Section B1 describes the individual sampling locations.

Sampling staff are trained in general water sampling procedures and specifically for the water sampling equipment to be used for this project. Training includes proper sampling procedures to avoid sample contamination or cross-contamination between samples, methods for collecting samples using the Wildco® VOC sampler and the Kemmerer

water sampling bottle and procedures for measuring depth transparency using the Secchi disk. Sampling staff assigned to this project are also trained in the use of the motorboat, including safety while driving with the trailer and while operating the motorboat.

Samples will be submitted to the contracted laboratories, SGS and Analytica. Laboratories will provide the sampling containers, coolers, gel ice, trip blanks and temperature blanks for each sampling event. Upon receipt of the samples, the laboratories will analyze them for the analytical parameters listed in Table 1 and report results both in hard-copy format and in electronic form (Access database) by normal turn around times.

Data obtained over the course of the program, including weather data described below, will be entered into a Microsoft Access database following ADEC guidelines as referenced in the project scope of work. Numeric or other abbreviated coding schemes will be avoided, and departmental data management guidance such as that described at http://www.state.ak.us/dec/das/is/consdata/home/htm will be applied as appropriate.

Appropriate data validation reporting requirements as detailed in Section D will be included in the Final Report.

Deliverable: Results for laboratory analyses and field parameters will be included in the database delivered with the Final Report.

Schedule: Sampling will be conducted on May 9, May 16, May 29/30 and June 12/13. The Final Report will be completed July 30.

Weather Conditions

During the sampling season (May and June), weather conditions will be obtained from the NOAA National Weather Service website (http://www.arh.noaa.gov/obs.php) for weather observations at the Wasilla Airport. Precipitation data will also be obtained from NOAA's National Climatic Data Center (NCDC) for inclusion in the final Access database. Data collected will include weather observations for the week and month prior to sampling events. Parameters that will be reported include total precipitation, precipitation duration, average temperature and dew point. These data will be compared to annual or seasonal data for the sampling locations to help determine if representative weather conditions have been met for each sampling event.

Deliverable: Database of weather conditions during the sampling events (May and June).

Schedule: Weather conditions will be included in the Final Report.

Schedule: completed by July 30, 2004.

Draft Report

The Draft Report will include the complete sampling results from the May and June sampling events. Samples will be analyzed and compared to state pollutant standards from 18 AAC 70. The Draft Report will be submitted on June 23, 2004 for review by ADEC.

The Draft report will analyze the complete data set for the project. Data will be used to answer a series of questions that will help to manage source inputs on Big Lake and Lake Lucille:

- What sources are contributing nutrients, bacteria or hydrocarbons?
- Where are levels of nutrients, bacteria and hydrocarbons the highest?
- Are there exceedances of water quality standards?
- Are representative habitats being impacted? Are hydrocarbon concentrations in representative habitats higher or lower than at other locations on both lakes?
- Are swimming areas being impacted? Is swimming safe at the swimming areas on both lakes?
- Is additional sampling beyond the scope of this project necessary?

Results will be used by ADEC staff and other agencies to make management decisions to protect Big Lake and Lake Lucille for all of its uses.

Deliverable: Draft Final Report

Schedule: completed by June 23, 2004.

Final Report

A Final Report will be prepared following ADEC review of the Draft Final Report and will incorporate comments from that review. Photographic records and the project database will be submitted with the Final Report.

Deliverable: Final Report with database

Schedule: completed by July 30, 2004.

A7. Data Quality Objectives and Criteria for Measurement of Data

Project Data Quality Objectives

The overall Quality Objective of this QAPP is to ensure that the state water quality criteria for the contaminants of concern are accurately monitored at Big Lake and Lake Lucille.

Detection limits for the analytical methods must be comparable to the levels of concern in order to meet data quality objectives. The levels of concern used for this project are the water quality criteria in 18 AAC 70 for hydrocarbons. A summary of the parameters, their associated analytical methods with practical quantitation limits (PQLs) and the levels of concern are provided in the following table. Practical quantitation limits are defined by the EPA as "the lowest concentration of an analyte that can be reliably measured within specified limits of precision and accuracy during routine laboratory operating conditions."

Table 1. Parameter PQLs and Levels of Concern

Analyte	Method	Practical Quantitation Limit[1]	Levels of Concern[1]
Color	SM 2120B	5 PCU	15 color units
Total Phosphorus	EPA 365.2	0.1 mg/L	NA
Dissolved Phosphorus	EPA 365.2	0.1 mg/L	NA
O-Phosphorus, dissolved	EPA 365.2	0.1 mg/L	NA
Kjeldahl Nitrogen	SM 4500-N D	0.5 mg/L	NA
Ammonia	SM 4500-NH3 F	0.1 mg/L	*pH dependent*
Nitrate + Nitrite	EPA 300.0	0.1 mg/L	10 mg/L
Particulate Organic Carbon	EPA 415.1	0.5 mg/L	NA
Alkalinity	SM 2320B	10 mg/L	>20 mg/L (minimum)
Fecal Coliform	SM 9222D	0 colonies/100 mL	20 FC/100mL
Chlorophyll a	SM 10200H	3.0 mg/m3	NA
E. coli	SM 9223 Quant Tray	0 colonies/100 mL	presence
Benzene	EPA 624	0.4 ug/L	TAH 10 ug/L
Toluene	EPA 624	1.0 ug/L	TAH 10 ug/L
Ethylbenzene	EPA 624	1.0 ug/L	TAH 10 ug/L
Xylene	EPA 624	2.0 ug/L	TAH 10 ug/L
Acenaphthene	EPA 610	0.5 ug/L	TaqH (TAH+ PAH) 15 μg/L
Ancenaphthylene	EPA 610	0.5 ug/L	TaqH (TAH+ PAH) 15 μg/L
Anthracene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Benzo[a]anthracene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Benzo[a]pyrene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Benzo[b]fluoranthene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Benzo[g,h,i]perylene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Benzo[k]fluoranthene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Chrysene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Dibenzo[a,h]anthracene	EPA 610	0.1 ug/L	TaqH (TAH+ PAH) 15 μg/L
Fluoranthene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Fluorine	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Indeno[1,2,3-c,d]pyrene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Naphthalene	EPA 610	0.5 ug/L	TaqH (TAH+ PAH) 15 μg/L
Phenanthrene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
Pyrene	EPA 610	0.2 ug/L	TaqH (TAH+ PAH) 15 μg/L
pH	In situ (electronic probe)	+/- 0.01 pH units	<6.5 and <8.5 pH units
Dissolved oxygen	In situ (electronic probe)	+/- 0.01 mg/L	<7 and <17 mg/L
Turbidity	In situ (electronic probe)	+/- 1 NTU	5 NTU above natural conditions

Temperature	In situ (electronic probe)	+/- 1°C	13 °C
Conductivity	In situ (electronic probe)	0-1: 0.001 1-10: 0.01 10-100: 0.1 (mS/cm)	NA
Salinity	In situ (electronic probe)	+/- 0.01%	NA

NA - Not applicable
1 – for a discussion of PQLs and Levels of Concern, see Section A7 above.

Criteria for Measurement of Data

Criteria for Measurements of Data are the performance criteria: accuracy, precision, comparability, representativeness and completeness of the tests. These criteria must be met to ensure that the data are verifiable and that project quality objectives are met.

OASIS' objectives for accuracy, precision, comparability, representativeness and completeness are summarized in this section. OASIS' contracted laboratories, SGS and Analytica, are laboratories ADEC-certified for drinking water analyses. A copy of their Quality Management Plan (QMP) is on file with the ADEC Water Quality Assurance Officer, which includes the laboratory measurement criteria. The QA/QC measures included in the SGS and Analytica QMPs are not repeated in this document.

Accuracy

Accuracy is a measure of confidence that describes how close a measurement is to its "true" value. Methods to ensure accuracy of field measurements include instrument calibration and maintenance procedures discussed in Section B of this QAPP. Sample handling procedures are also discussed in Section B and review of these procedures for verification of data is included in Section D.

Laboratory accuracy is normally determined by the percent recovery of the target analyte in spiked samples and also by the recoveries of the surrogates in all samples and QC samples. Laboratory accuracy ranges are specified in SGS' Quality Management Plan (kept on file at ADEC) and depend on the parameter being measured. Accuracy is calculated as follows:

$$\%R = \frac{\text{Analyzed value}}{\text{true value}} \times 100$$

OASIS will ensure laboratory accuracy by meeting %R values specified by EPA methods listed in Table 4 in Section B4.

Precision

Precision is the degree of agreement among repeated measurements of the same characteristic, or parameter, and gives information about the consistency of methods.

Precision is expressed in terms of the relative percent difference (RPD) between two measurements (A and B), and is computed as follows:

$$RPD = \frac{A - B \times 100}{(A+B)/2}$$

Field and lab precision is measured by collecting blind (to the laboratory) field duplicate samples. One duplicate QC sample will be collected on each sample event date.

OASIS and SGS and Analytica (per their QMPs) ensure laboratory precision by measuring Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples and by the analysis of laboratory duplicate samples. One set of MS/MSD and duplicate samples will be analyzed per batch of samples. OASIS will use RPDs specific to the EPA method listed in Table 4 in Section B4 for each sample parameter.

Representativeness

Representativeness is the extent to which measurements actually represent the true environmental condition. Representativeness of data collected is part of the sampling program developed by ADEC and outlined in the scope of work. The locations of the sampling sites are based on the possible sources inputting nutrient, bacteria and hydrocarbon contamination to Big Lake and Lake Lucille. Sampling sites for nutrients were chosen where there are high densities of houses where fertilizers, septic systems and pet waste exist and also areas where wildlife populations are high or fish carcasses accumulate. Bacteria sampling sites were chosen also in high density housing areas to target human and animal waste and also wildlife concentration areas. Swimming areas will be sampled for bacteria to determine if levels are above the contact recreation WQS. Hydrocarbon sites were chosen near to boat launches, maintenance and fueling areas, traffic lanes for boats, planes and small motorcraft and areas of high density housing.

The timing of sample collection is based on the high density of users experienced at both lakes on weekends during the summer months. Hydrocarbon sampling on both lakes will occur on Saturday afternoon/evening when motorboat use is expected to be the highest. Other sampling will not be as time-sensitive but will be conducted during the morning Saturdays at Lake Lucille and on Sundays at Big Lake.

OASIS will ensure the representativeness of the data by recording weather conditions throughout the sampling season (see discussion of task in Section A6), using consistent sampling methods and ensuring quality during sample collection, handling and transport (see Sections B2 and B3).

Comparability

Comparability is the degree to which data can be compared directly to similar studies. Standardized sampling and analytical methods and units of reporting with comparable sensitivity will be used to ensure comparability. Analytical sample analysis will be performed following EPA-approved procedures by the ADEC certified laboratories, SGS and Analytica.

Completeness

Completeness is the comparison between the amount of usable data collected versus the amount of data called for in the scope of work. OASIS will determine completeness by comparing sampling and analyses completed with the requirements in the scope of

$$\frac{T - (I+NC)}{T} \times (100\%) = \text{Completeness}$$

Where T = Total number of expected measurements.
I= Number of invalid results.
NC = Number of results not produced (e.g. spilled sample, etc.).

work. OASIS' goal is to complete 95%+ of required monitoring. The following equation is used to calculate completeness:

A8. Training and Certifications

Sampling personnel are trained in sampling methods, sample handling, chain-of-custody, sample transport, and field laboratory measurements. Personnel analyzing and reporting data are qualified to conduct these tasks per their experience with surface water sampling at various sites in the state and with 18 AAC 70 water quality criteria. Resumes of all project personnel are on file with ADEC as part of the Water Quality Term Contract. The contracted laboratories, SGS and Analytica, are ADEC-certified labs for drinking water analyses. Other certifications held by the laboratories and their staff are on file at SGS and Analytica and may be requested by ADEC.

A9. Documents and Records

Field notebooks will be filled out using *Write in the Rain* ink or pencil, and should not be erased. Changes are made by crossing out errors, initialing, and adding correct information. Field notebooks will be bound with numbered pages.

Laboratory data results are recorded on laboratory data sheets, bench sheets and/or in laboratory logbooks for each sampling event. These records as well as control charts, logbook records of equipment maintenance records, calibration and quality control checks, such as preparation and use of standard solutions, inventory of supplies and consumables, check in of equipment, equipment parts and chemicals are kept on file at the laboratory.

Any procedural or equipment problems are recorded in the field notebooks. Any deviation from this Quality Assurance Project Plan will also be noted in the field notebooks. Data results returned to ADEC will include information on field and/or laboratory QA/QC problems and corrective actions.

Standard turnaround time for the analytical samples taken to SGS will be 7-10 working days. Analytica will be performing the chlorophyll a analysis which will have a standard turnaround time of 10 working days.

Chain-of-Custody and/or Transmission forms will be kept with the sample during transport and will accompany data results back to ADEC. Training records and data

review records will be kept on file at OASIS, SGS and Analytica and will be available on request by ADEC. All sample analysis records and documents are kept at SGS and Analytica and are available to EPA and ADEC for inspection at any time.

In addition to any written report, data collected for the project will be provided electronically to ADEC via a CD-ROM or Email ZIP file. Both the original application file and a comma delimited text file will be provided. The text file will be an ASCII (text) file, with fields separated by commas, comma de-limited; often "CSV" (comma separated value), text enclosed in quotes. Spaces are **not** permitted between fields. Blank lines are **not** permitted in the file. All dates **must** be formatted as "**MM-DD-YYYY**."

All records will be retained by SGS and Analytica for five years. All project records at OASIS are retained permanently.

B. Data Generation and Acquisition

B1. Sampling Process Design

This project will include sampling events for water quality parameters at Big Lake and Lake Lucille in order to evaluate the extent of possible nutrient, bacteria and hydrocarbon contamination in these lakes during the summer. Multiple sites will be sampled on each lake for each group of parameters. At Lake Lucille, there will be four sampling sites each for nutrients, bacteria and hydrocarbons. At Big Lake, there will be six sampling sites for nutrients and fourteen sampling sites for bacteria and hydrocarbons. The locations of the sampling sites will be based on source inputs in the immediate area (boat launches, parks, septic systems, lawns, animal concentration areas). Locations will overlap for many of the sampling sites between parameter groups. For example, both nutrients and bacteria may be sampled from many of the same sites near to houses where fertilizers, septic systems and animal waste may all contribute to contamination. On each lake, one of the sites for each of the parameter groups will be used as a background site, away from source inputs where contamination is not expected.

The sample events will be conducted using a 15' aluminum skiff with a 25 horsepower outboard motor. The boat will be launched at Lake Lucille at the undeveloped boat launch at the east end of the lake accessible off of Park Avenue. The boat will be launched at Big Lake at the North Shore State Recreation Area accessible off of North Shore Drive. Sampling at both lakes will start on the west side in the less developed areas. If wind or wave action on either of the lakes creates enough force to move the boat, an anchor will be dropped to hold the boat at each sampling location. The motor will be turned off to avoid contaminating the samples during collection. Hydrocarbon sampling will not begin until the motor has been turned off for at least one minute. All sample site locations will be identified using a GPS receiver and through landmarks logged in the field notebook.

Sampling locations marked on the maps in Figures 1 and 2 were determined based on discussions with Laura Eldred of ADEC and other local contacts.[1, 2] Exact locations for the sampling sites will be finalized during the first sampling events, on May 8 for Lake Lucille and May 15/16 for Big Lake. Site locations will be recorded using a GPS receiver, photographed and marked on the map. Of the fourteen sampling sites at Big Lake for bacteria and hydrocarbons, two will be selected during the first sampling event based on observation of shoreline development and recreational activity on the lake.

Table 2 includes a description of each numbered sample site in the figures along with the parameter groups that will be sampled there. For some parameters there are additional sites and the final sampling locations will be determined during the first sampling events in May. Six of the fourteen bacteria sampling locations on Big Lake and two of the four bacteria sampling locations on Lake Lucille will be collected at swimming

[1] Rutz, Dave. Alaska Department of Fish and Game. Personal communication. May 4, 2004.
[2] Fuller, Lynn. Matanuska-Susitna Borough. Personal communication. May 3, 2004.

areas. Samples will be collected one foot below the surface for both analyses at three sites offshore where the water is three feet deep.[3] One set of nutrient samples will be collected at one of the primary sample locations at a swimming area. At swimming areas or in shallow sections of Lake Lucille, where the lake depth is less than 7 feet, only one set of nutrient samples will be collected.

Where samples are collected to target shoreline development such as boat launches, public parks or residential development, sampling locations will be approximately 100-200' offshore depending on the length of shoreline development. For example, at a small area such as a marina boat launch, the sampling site may be 100' offshore. At an area of dense residential development which extends for >1000', the sampling location may be up to 200' offshore.

Table 3 details the dates and locations for each sampling event. One duplicate will be collected at Lake Lucille on each sampling date and submitted for all analyses. At Big Lake, one duplicate will be collected and submitted for nutrient analyses, four duplicates for fecal coliform analysis, three duplicates for E. coli analysis and two duplicates for hydrocarbon analyses. Two decontamination blanks will be collected at each lake during the second and third sampling events; one each from the VOC sampler and the Kemmerer water sampling bottle.

Conditions on the lake may exist during a sampling event which will affect accessibility to the sampling locations or sample integrity. If a sampling site is inaccessible due to other lake users occupying the area, samplers will move on to other locations and return later. If necessary, OASIS staff will request permission to access a sampling location temporarily to collect water for analyses. Weather conditions may affect sample integrity such as rain, wind or sunshine (for chlorophyll a samples). A tarp or other cover will be used to collect samples during rain events or while filtering chlorophyll a samples. Chlorophyll a in water can degrade when exposed to light and filtration will be performed under a shield immediately upon collecting the water sample. On windy days or when other motorized traffic causes extensive wave action or spray, sampling equipment will be stored on the boat floor and samplers will use caution while sampling to ensure all sampling equipment is protected from cross-contamination. Any modifications to methods due to unforeseen conditions will be documented thoroughly in the field notebook and reported to ADEC. For information on possible failure of field equipment or instruments, see Sections B2 and B6 respectively.

[3] EPA, **Time-Relevant Beach and Recreational Water Quality Monitoring and Reporting, EPA 625/R-02/017, October 2002, http://www.epa.gov/ORD/NRMRL/Pubs/625R02017/625R02017.htm#options accessed on May 6, 2004.**

Table 2. Sampling Site Descriptions

Lake	Sample Site	Description	Nutrients	Bacteria	Hydrocarbons
Lucille	1	Historic USGS sampling site	X	X	X
Lucille	2	Public boat launch and public park	X	X	X
Lucille	3	Campground and landing strip	X	X	X
Lucille	4	Lucille Creek	X	X	
Lucille	5	Residential development, private boat launch and plane guide service at Best Western	X	X	X
Big	1	Historic USGS sampling site	X	X	X
Big	2	Residential development		X	X
Big	3	Boat traffic lane			X
Big	4	Residential development		X	X
Big	5	Boat traffic and shoreline development		X	X
Big	6	Shoreline development	X	X	X
Big	7	Meadow Creek		X	
Big	8	Public boat launch and state park	X	X	X
Big	9	Historic USGS sampling site	X	X	X
Big	10	Residential development	X	X	X
Big	11	Public boat launch and state park	X	X	X
Big	12	Marina-boat launch		X	X
Big	13	Fish Creek	X	X	
Big	14	Marina-boat launch		X	X
Big	15	Residential development	X	X	X

Table 3. Sample Dates and Locations

Sample Type	May 8	May 16	May 29*	May 30	June 12*	June 13	Totals
Nutrients	8	12	8	12	8	12	66
duplicates	1	1	1	1	1	1	
Fecal coliform	12	42	12	42	12	42	177
duplicates	1	4	1	4	1	4	
E. coli	8	26	8	26	8	26	114
duplicates	1	3	1	3	1	3	
TAH	16	26	42	0	42	0	141
duplicates	1	2	3	0	3	0	
trip blanks	1	1	2	0	2	0	
PAH	8	13	21	0	21	0	72
duplicates	1	2	3	0	3	0	
Decontamination Blanks	0	0	2	2	2	2	17
Standard Chemistry Parameters	All sites	All sites	All sites	All sites	All sites	All sites	6
duplicates	1	1	1	1	1	1	

*Hydrocarbon samples for both lakes will be collected on Saturday afternoon/evening during the second and third sampling events to target the period when the highest number of motorized recreational users are expected.

B2. Sampling Methods

Sample sites will be accessed using a 15' aluminum skiff with a 25 hp outboard anchored if wave action or winds deem it necessary to remain at the sampling locations. A minimum of two people will man the boat during all sample events. Sampling sites will be located using a GPS receiver.

Nutrient samples will be collected using a Kemmerer water sampling bottle disposed to two sampling depths, 1 m and 75% of total depth, and raised for sample collection. Chlorophyll a samples require a specific procedure outlined below.

1. The Kemmerer bottle will be filled at the sample site and depth and brought to the boat for filtration under an area shielded from sunlight to prevent photodecomposition.
2. A new filter for each sample will be placed inside the porcelain funnel. The funnel will be placed in a stopper on top of the beaker to which the vacuum pressure will be applied.
3. 1-L of sample volume will be measured in a graduated cylinder and added to the porcelain funnel for filtration.
4. The peristaltic pump will be used to apply a vacuum onto the beaker and suck the sample from the funnel through the filter. If the filter does not appear green after 1-L of water has been filtered, a second liter of sample will be filtered.
5. The filter will be removed by a sampler wearing nitrile gloves and folded in half twice with the chlorophyll a on the inside. The filter will be placed in a Ziploc bag and sealed. The sample number will be written on the outside of the bag.
6. The Ziploc bag will be wrapped in aluminum foil, placed between two frozen packs of gel ice and stored in a cooler for transport to the laboratory.

Bacteria samples will be collected as grab samples at approximately 1-foot below the surface using the following procedure:

1. Sampler will put on nitrile gloves.
2. The sample bottle will be lowered, while closed, to 1-foot below the water surface.
3. The bottle will be uncapped, allowed to fill and recapped while still at 1-foot depth.
4. The bottle will be dried and labeled after sampling.

Protocols for grab sampling will follow the USGS report, National Field Manual for the Collection of Water Quality Data.[4]

[4] U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, available online at http://pubs.water.usgs.gov/twri9A.

Hydrocarbon samples will be collected in accordance with the USGS report "Field guide for collecting samples for analysis of volatile organic compounds in stream water for the National Water Quality Assessment Program (USGS Open File Report 97-401)."[5] This report contains detailed instructions on sample collection procedures using the USGS-designed VOC sampler distributed by Wildco®.

One sample to be analyzed for TAH will be collected (3 vials) from each lowering of the VOC sampler. A 1:1 HCL solution will be added to each vial after sample collection for preservation and capped (~5 drops). The samples will be checked to ensure that there are no air bubbles after capping. To fill the two 1-L bottles needed for PAH analysis, the sampler will be lowered in the same spot two additional times and the sample will be collected directly from the stainless steel container. No preservative is needed for PAH analysis. A duplicate sample will be obtained by lowering the sampler in the same spot immediately after collecting the project sample. Hydrocarbon samples will be collected at four depth intervals at each site: 15 cm, 45 cm, 1.5 m and 5 m.

Prior to collecting a sample from a site, the water sampling equipment will be decontaminated in Alconox and deionized water, rinsed with deionized water and submerged in the lake at the new collection site and allowed to flush completely. The VOC sampler will be submerged for approximately four minutes so that the copper tubes can allow enough volume into the sampler for a complete flushing. Four decontamination quality control samples will be collected for both the VOC sampler and the Kemmerer bottle (two at each lake) on separate dates to ensure that cross-contamination is not occurring between sample sites.

The decontamination quality control sample will be collected using the following procedure. Both pieces of water sampling equipment will be used to sample at a site near to a possible contamination source. The samplers will be decontaminated following the procedure described above. Both samplers will be submerged twice in a clean bucket with DI water, once to simulate the flushing at the new site and a second time to collect the decontamination quality control sample. Samples will be analyzed for all analyses to ensure the decontamination procedure is adequate. This process will be used after four sites, two on each lake, on May 29/30 and June 12/13.

Should any of the sampling equipment fail during sampling and require maintenance, the project manager will contact the appropriate technical support for repair. Parts for both of the water sampling devices can be ordered and received via 2-day shipment. Due to the expense of many of the sampling supplies, duplicates could not be purchased for backup during sampling events. If a critical sampling device were to fail during a sampling event, all efforts will be made to conduct on-site repair in order to complete sample collection.

To ensure sample integrity, specific sampling and documentation procedures will be followed. This process will include labeling containers prior to sampling, extensive sample and site information recording, appropriate sample handling and comprehensive

[5] U.S. Geological Survey, 1997, Field guide for collecting samples for analysis of volatile organic compounds in stream water for the national Water Quality Assessment Program.

chain-of-custody procedures. All samples will be immediately placed on gel ice after sampling and will remain chilled to ~4°C during transportation to the laboratory. Holding times for each sample analysis are provided in Table 4. Four analyses have short hold times; fecal coliform, E. coli, color and dissolved ortho-phosphate. Bacteria and nutrient sampling will be conducted on Saturdays at Lake Lucille and Sundays at Big Lake during one round of sampling at each site. All bacteria and nutrient samples will be rushed to SGS in Anchorage immediately after sampling in order to meet the short hold times. Sample documentation procedures will include field notebooks, chain-of-custody forms and sample labels. Specific information such as site identification, sample identification numbers, sampling observations and sample collection time and date will be recorded in field notebooks. Additionally, photo documentation will be collected during each sampling event.

Standard chemistry parameters (pH, temperature, conductivity, dissolved oxygen and turbidity) will be measured at 1-meter intervals at all sampling sites using a multi-parameter water quality meter and recorded in the field notebook. Prior to, and after each sampling event, all field meter probes will be rinsed with de-ionized water. A Secchi depth transparency test will also be performed at each sampling site following the procedure below.

1. The Secchi disk will be lowered off of the side of the boat using a graduated line.
2. When the black and white partitions on the Secchi disk are no longer discernible, the lowering depth transparency measurement will be recorded in the field notebook.
3. The disk will be lowered until it is no longer visible and raised. When the black and white partitions are visible again, a second depth will be recorded for comparison with the first measurement.
4. If the two measurements vary by >20%, repeat the process, collect two additional measurements and average the four.

Unique sample IDs will be based on the following format:

- *WW-X(Y)*
- WW = Lake ID, BL for Big Lake and LL for Lake Lucille.
- X = sample site. See Appendix 1 for a map of the sampling locations and specific sampling site numbers.
- Y = sample depth. For nutrient samples, depths will be labeled 1 for samples collected at 1 meter depth and samples collected at 75% of total depth will be labeled with the depth they were collected at in meters. For bacteria samples, no depth suffix will be appended because the samples will be collected just below the surface. For hydrocarbon samples, .15, .45, 1.5 and 5 will be used to indicate the sampling depth in meters.

The duplicate sample on each date will be labeled with a fictitious sample site number that will be recorded in the field notebook.

Sample labels will include the sample ID, date sampled, time sampled, sampler initials, analysis and any special instructions to the laboratory.

B3. Sample Handling and Custody

Individual samples for analysis will be placed in the appropriate pre-cleaned sample containers as shown in Table 3. To ensure sample integrity, specific sampling and documentation procedures will be followed. These procedures will include labeling containers prior to sampling, extensive sample and site information recording, appropriate sample handling and comprehensive chain-of-custody procedures. Sample and site information will be recorded in the field notebooks. Quality control samples or additional sample volume for laboratory QC will be collected as appropriate and are discussed in more detail in B5. All samples will be immediately placed in coolers and packed with gel ice after sampling and will remain chilled to 4°C during transportation to SGS in Anchorage, Alaska. All samples shipped will be accompanied with completed chain-of-custody forms and coolers will be sealed with signed and dated fiber tape for shipment. Holding times and sample preservation requirements are described in Table 3. Holding times for each sample analysis type will be met.

Table 4. Preservation and Holding Times for the Analysis of Samples

Analyte	Matrix	Container	Preservative and Filtration	Holding Time
Color	water	1 x 1 L HDPE	4° C	48 hours
Total Phosphorus	water	1 x 1 L HDPE	H_2SO_4, 4° C	28 days
Dissolved Phosphorus	water	1 x 1 L HDPE	Field filter, H_2SO_4, 4° C	28 days
O-Phosphorus, dissolved	water	1 x 1 L HDPE	Field filter, 4° C	48 hours
Kjeldahl Nitrogen	water	1 x 1 L HDPE	H_2SO_4, 4° C	28 days
Ammonia	water	1 x 1 L HDPE	H_2SO_4, 4° C	28 days
Nitrate + Nitrite	water	1 x 60 mL nalgene	H_2SO_4, 4° C	28 days
Particulate Organic Carbon	water	2 x 250 mL amber glass	Field filter one container, HCl, 4° C	28 days
Alkalinity	water	1 x 1 L HDPE	4° C	14 days
Fecal Coliform	water	120 mL sterile plastic	4° C	6 hours
Chlorophyll a	water	1000 mL of sample on filter	See methods in B2, 4° C	30 days
E. coli	water	120 mL sterile plastic	4° C	6 hours
TAH	water	3 x 40-mL vials	HCL to <2 pH, 4 °C	14 days
PAH	water	2 x 1-L amber glass	4°C	7 days

Sample documentation procedures will include project field notebooks, chain-of-custody forms and sample labels. Specific information such as site identification, sample identification numbers, sampling observations and sample collection time and date will be recorded in field notebooks. Additionally, photographic documentation will be collected during each sampling event.

B4. Analytical Methods

Water quality analytical methods that will be used throughout this project are outlined below. All analysis methods used for this program are EPA-approved. The contracted laboratories, SGS and Analytica, are ADEC-certified for drinking-water analyses. SGS and Analytica have Quality Management Plans (QMP) on file with ADEC detailing their quality assurance procedures. Laboratory turnaround times are 7-10 working days for SGS and 10 working days for Analytica. Any issues regarding analytical data quality will be resolved by the OASIS project manager through discussions with the laboratory project managers.

Table 5. Analytical Methods Precision and Accuracy

Analyte	Method	Precision (RPD)[1]	Accuracy (%R)[1]
Benzene	EPA 624	20%	88-117%
Toluene	EPA 624	20%	87-115%
Ethylbenzene	EPA 624	20%	80-120%
Xylene	EPA 624	20%	NA
Acenaphthene	EPA 610	32%	21-100%
Ancenaphthylene	EPA 610	27%	34-119%
Anthracene	EPA 610	25%	31-111%
Benzo[a]anthracene	EPA 610	15%	68-125%
Benzo[a]pyrene	EPA 610	28%	53-116%
Benzo[b]fluoranthene	EPA 610	25%	64-126%
Benzo[g,h,i]perylene	EPA 610	34%	13-109%
Benzo[k]fluoranthene	EPA 610	29%	60-122%
Chrysene	EPA 610	23%	66-128%
Dibenzo[a,h]anthracene	EPA 610	32%	2.5-102%
Fluoranthene	EPA 610	24%	57-129%
Fluorine	EPA 610	30%	28-111%
Indeno[1,2,3-c,d]pyrene	EPA 610	30%	52-119%
Naphthalene	EPA 610	30%	21-89%
Phenanthrene	EPA 610	30%	36-133%
Pyrene	EPA 610	26%	61-132%
Color	SM 2120B	20%	NA
Total Phosphorus	EPA 365.2	25%	75-125%
Dissolved Phosphorus	EPA 365.2	25%	75-125%
O-Phosphorus, dissolved	EPA 365.2	25%	75-125%
Kjeldahl Nitrogen	SM 4500-N D	25%	75-125%
Ammonia	SM 4500-NH3 F	25%	75-125%
Nitrate + Nitrite	EPA 300.0	20%	NA

Particulate Organic Carbon	EPA 415.1	25%	75-125%
Alkalinity	SM 2320B	20%	90-110%
Fecal Coliform	SM 9222D	NA	NA
Chlorophyll a	SM 10200H	NA	NA
E. coli	SM 9223 Quant Tray	NA	NA

1- for a discussion of Precision (RPD) and Accuracy (%R), see Section A7.

B5. Quality Control

Quality control activities in the field will include adherence to documented procedures and the comprehensive documentation of sample collection information included in the field notebooks. A rigidly enforced chain-of-custody program will ensure sample integrity and identification. The chain-of-custody procedure documents the handling of each sample from the time the sample was collected to the arrival of the sample at the laboratory.

Analytical methods in use on the program have been approved and documented by EPA. These methods will be used as project-specific protocols to document and guide analytical procedures. Adherence to these documented procedures will ensure that analytical results are properly obtained and reported.

Quality control activities in the field will consist of the following items:

- Adherence to documented procedures in this QAPP,
- Cross-checking of field measurements and recording to ensure consistency and accuracy and
- Comprehensive documentation of field observations, sample collection and sample identification information.

Internal laboratory quality control checks will include the use of surrogate solutions and quality control samples such as procedural (or method) blanks, laboratory control blanks, matrix spike/spike duplicates, standard reference materials (SRMs) or EPA QC check samples and duplicates as specified in the EPA approved analytical procedures. Surrogate compounds will be spiked into the samples as appropriate to measure individual sample matrix effects that are associated with sample preparation and analysis.

In addition to laboratory QC samples, multiple field quality control samples will also be collected. One field duplicate sample will be collected during each sampling date and sent to the lab blind to test for precision of analytical procedures. A trip blank will be submitted to the lab during each sampling event to ensure that equipment handling and transport procedures do not introduce contamination. Four decontamination blanks will be collected at different periods throughout the program to assure that cross-contamination between samples is not occurring (see Section B2, Sampling Methods). A list of the quality control samples and their frequency is included in the table below.

Table 6. Quality Control Samples

Quality Control Sample	Frequency
Method Blanks	1/batch
Matrix Spike/Matrix Spike Duplicates	1/batch
Laboratory Control Sample/Laboratory Control Sample Duplicate	1/batch
Surrogate Compounds	3/EPA 624 1/EPA 610
Field Duplicate	1/sampling date
Trip Blank	1/sampling date
Decontamination Sample	4 total for each sampler

Laboratory duplicates and the blind field duplicate will be compared to the RPD criteria for the methods provided in Table 4. Spiked QC samples including surrogates, matrix spikes and laboratory control samples will be compared to the %R values in Table 4. Concentrations of contaminants of concern reported in method blanks will be compared to reported values in the analytical samples. If analytical sample results are less than five times the concentration reported in the method blank, then results will be reported as a laboratory contaminant.

Results from quality control samples allow the assessment of quality assurance parameters such as accuracy and precision of the data. Any data falling outside the acceptable criteria as defined in the methods will be appropriately investigated and qualified as described in Section D2.

B6. Instrument/Equipment Testing, Inspection and Maintenance

Field equipment used for collection, measurement and testing will be subject to a strict program of control, calibration, adjustment and maintenance. Water quality parameters including TAH and PAH will be collected for laboratory analysis in the field using a Wildco VOC sampler, described in Appendix 2. Routine maintenance of the VOC sampler will be conducted prior to each sampling event. Maintenance will include a visual inspection that all parts are present, attached correctly and devoid of any obvious contamination. The sampler will be submerged in river water for 10 seconds with bottles inside the sampler to check that all four copper tubes are not blocked and are sampling correctly. Parts for the VOC sampler and the Kemmerer bottle can be ordered directly from Wildco and shipped within two working days. The project manager will coordinate ordering replacement parts and repairing samplers.

Water quality parameters including pH, conductivity, salinity, turbidity and temperature will be measured in the field during each sampling event using a Horiba U-22 field meter. Routine maintenance on the Horiba will be conducted according to schedules described in the manual provided by the manufacturer and recorded in the maintenance log stored in its carrying case. The Horiba U-22 will be rented from PSI in Anchorage. All technical maintenance or repairs will be reported to their trained staff upon completion of each sampling event for corrective action.

B7. Instrument/Equipment Calibration and Frequency

Care will be taken to ensure that the Horiba used for field measurements is calibrated and adjusted prior to each sampling event using known buffer solutions that are included with the Horiba U-22.

Horiba U-22

The Horiba U-22 will be calibrated using the following procedures. Fill the beaker with the standard pH 4.0 buffer solution. Immerse the probe in the beaker while ensuring that the DO sensor is kept outside of the solution as it is calibrated to atmospheric air. With the power on, press the mode key to put the instrument in maintenance mode. Use the mode key to move the lower cursor to auto if it is not already there. Press enter and the unit will auto-calibrate through four parameters: pH, conductivity, turbidity and dissolved oxygen.

All calibration measurements will be recorded on the appropriate field forms or in field logbooks and will be available for review by ADEC upon request.

B8. Inspection/Acceptance of Supplies and Consumables

All buffer solutions used for field instrument calibration will be checked for expiration date, sufficient quantity, and discoloration.

Qualified field staff will check all field equipment and supplies that are required for this project to ensure their technical specifications before use. Evaluation criteria that will be used are listed below:

- Ensuring that equipment and supplies have been cleaned if they are reusable or are sterile if they are packaged,
- Equipment is in serviceable condition and
- The appropriate chain-of-custody procedures have been taken if equipment or supplies were shipped.
- Cooler temperature will be maintained at 4 °C +/- 2 °C.

Any deviances during inspection procedures will be remedied by the project manager and recorded in the field notebook. If necessary, replacements to shipped consumables will be made.

Coolers, gel ice, samples containers, and chain-of-custody forms will be provided by SGS prior to field mobilization. Extra sample containers will be available in the event re-sampling becomes necessary. All COC records will be kept at OASIS should ADEC request to see them.

B9. Non-Direct Measurements

Non-direct measurements collected for this project include:

- Interviews with local citizens or agency staff regarding recreational usage and point sources on both lakes,

- Matanuska-Susitna Borough GIS mapping layers,
- Weather data, and
- Topographic maps.

Interviews with local citizens or agency staff will be conducted over the phone prior to the first sampling events on each lake. Matanuska-Susitna Borough GIS mapping layers will be used to overlay on maps to be included in the Draft and Final Reports. Weather data will be obtained from the National Weather Service website. Topographic maps are from All Topo Maps software.

Information from interviews will provide guidance for selecting sites and will not be used to make final determinations until the lakes have been visited during the first sampling event. Topographic maps and GIS layers are both limited in the accuracy of their information based on the date they were updated. All efforts will be made to obtain up-to-date mapping layers. The dates for mapping layers will be provided in the Final Report.

B10. Data Management

Data obtained during sampling activities will be entered into field notebooks.

The following is a list of possible data information that will be kept at OASIS or SGS for ADEC review upon request:

- Field equipment and chemicals maintenance, cleaning and calibration records,
- Field notebooks,
- Sample Data Sheets (included as Attachment 1),
- Photographs of sampling stations and events,
- Chain-of-Custody forms,
- Laboratory equipment maintenance, cleaning and calibration records,
- Laboratory bench sheets, control charts, and SOPs,
- Records of QA/QC problems and corrective actions (field and/or laboratory),
- Laboratory data QC records,
- Records of data review sheets,
- Duplicate, performance evaluation records and other QA/QC control records (field and laboratory) and
- Data review, verification and validation records.

Data handling equipment will include computer software applications Microsoft Excel and Access. Data will be entered into the Access database in a form compatible with requirements of the statewide database entry into STORET. Requirements for data entry can be found in Section A9.

C. Assessment and Oversight

C1. Assessments and Response Actions

Should the sampling staff, laboratory personnel or Quality Assurance Officer find errors in sampling or analysis, the Quality Assurance Officer will notify the Project Manager and the party responsible for the error or deficiency and recommend methods of correcting the deficiency. The responsible party will then take action to correct the problem and will report corrections to the QA Officer and Project Manager.

The Quality Assurance Officer will review the QA/QC procedures used for the sampling and analytical program. Procedures for this review are included in Section D2 to meet the data quality criteria specified in A7. The Quality Assurance Officer will report these assessment records in the FY03 Interim Report and in the Draft and Final Reports.

C2. Reports to Management

Sampling results will be summarized in the Draft and Final Reports completed for this project. These reports will include the results of project assessments listed above. Reports will be submitted to the ADEC Project Manager. Email updates will be submitted to the ADEC Project Manager after each sampling event providing notification of any issues or problems for which corrective actions will be taken. The results of all corrective actions or data quality assessments will be reported to the ADEC Project Manager upon completion.

D. Data Validation and Usability

D1. Data Review, Validation & Verification Requirements

Analytical results will be reviewed and validated in accordance with United States Environmental Protection Agency (USEPA) documents, including the *USEPA Environmental Data Verification and Validation* (EPA QA/G-8), august 1999; the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 540/R-94/012), 1994; and the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 540/R-94/013), 1994.

OASIS will conduct data review and validation using the following methods on 10% of the primary project samples, including their associated quality control duplicates and laboratory quality control samples.

- A review of sample handling and analytical and field data for completeness, accuracy, holding time compliance, and quality control (QC) sample frequency compliance.
- Evaluation of laboratory blank samples.
- Evaluation of the accuracy and precision of field duplicate samples, laboratory control samples (LCS), and matrix spike/spike duplicate (MS/MSD) samples.
- Assignment of data qualifiers, when necessary, to reflect limitations identified in the data assessment process.
- Estimation of completeness.

D2. Validation and Verification Methods

The following procedures will be used to determine if data meets the data quality objectives and criteria specified in Section A7. If data QA/QC procedures do not meet the specified criteria, the Quality Assurance Officer will review all field and laboratory records to determine the cause. If equipment failures are limiting the usability of the data, calibration and maintenance procedures will be reviewed and changed as needed. If sampling or analytical procedures are causing the failures, methods will be reviewed to resolve the errors. Any changes or modifications to quality control procedures will be approved by ADEC prior to inclusion in the QAPP.

Review of Sample Handling

Proper sample handling techniques are required to ensure sample integrity. During data review, the sample handling procedures identified below are evaluated to determine potential effects on data quality.

- Review of field sample collection and preservation procedures to determine whether they were completed in accordance with the requirements specified by the analytical methods.

- Review of chain-of-custody documentation to ensure control and custody of the samples was maintained.
- Review of sample holding times between sample collection, extraction, and analysis (see Table 3 in Section B3).
- Review of sample conditions upon receipt at the contract laboratory.
- Review of Quality Assurance/Quality Control (QA/QC) Samples. Specific procedures for review of QA/QC samples are included in the sections below.

Laboratory Blank Samples

Laboratory blank samples (method and instrument blanks) are laboratory-prepared, analyte-free samples used to detect the introduction of contamination or other artifacts into the laboratory sample handling and analytical process. These blanks play an especially important role in sampling programs involving trace-level analyses or analytes that are common solvents found in a laboratory. None of the analytes of concern for this project are common laboratory contaminants. If a contaminant is discovered in the analytical sample at less than five times the concentration it is found in the laboratory blank, it will be considered a laboratory contaminant. Otherwise, it will be reported as an environmental contaminant.

Laboratory Control Samples

Laboratory control samples are used to assess analytical performance under a given set of standard conditions. Synthetic samples, containing some or all of the analytes of interest at known concentrations, are prepared independently from calibration standards. The samples consist of laboratory control samples (LCS) and laboratory control sample duplicates (LCSD). Laboratory control samples will be analyzed with each analytical batch. LCS may be used to estimate analytical accuracy and precision by comparing measured results to actual concentrations. LCS/LCSD percent recoveries will be checked on laboratory reports to ensure they are within the limits set by the EPA methods listed in Table 4.

LCS are also duplicated in the laboratory and then analyzed in an identical manner by the laboratory to assess the laboratory's internal precision. The analytical precision is expressed by the RPD (see calculation in A7). Analytical precision and accuracy should meet the method criteria listed in Table 4 in Section B4.

Matrix Spike and Matrix Spike Duplicates

Matrix spike samples are actual field samples to which known amounts of select compounds (one, or more, of the analytes of interest) are added. Both spiked and unspiked aliquots are analyzed. The difference between the concentration of the spike compound(s) in the spiked and unspiked aliquots is compared to the amount of spike added before the extraction process. Since actual samples are used for the recovery determination, the matrix effects can be evaluated. Usually expressed as a percentage of the mass of the spiked amount, spike recovery is the measurement of accuracy

anticipated for the sample matrix. Percent recoveries will be compared to EPA method-specific recoveries listed in Table 4.

Matrix spike samples are also duplicated in the laboratory and then analyzed in an identical manner by the laboratory to assess sample reproducibility and the laboratory's internal precision. The analytical precision is expressed by the RPD between the measurement results of the two duplicate samples. Analytical precision and accuracy should meet the criteria provided in Table 4. MS/MSD samples will be run on each batch of samples.

Surrogates

Surrogate compounds will be added to all samples being analyzed for TAH and PAH to evaluate analytical accuracy for each individual sample. Surrogate compounds are chemically similar to the analytes of interest but are not expected to be present in the field samples. Recovery of these surrogate compounds gives an estimate of the effectiveness of the extraction and analysis for each individual sample. Surrogate recoveries (%R) should meet the criteria provided in Table 4 for each analyte.

Field Duplicate Samples

Field duplicate samples will be collected simultaneously with a primary project sample. Duplicates are treated in the same manner as the primary sample during all phases of sample collection, handling, and analysis. Duplicate sample results are used to assess precision, including variability associated with both the laboratory analysis and the sample collection process (i.e., QC purposes). At least one duplicate field sample will be collected and submitted blind to the laboratory during each sampling date for this program.

Analytical results will be reviewed for agreement with each other or their respective reporting limits and evaluated for comparability. Estimated results quantified below the reporting limit and qualified with a "J" flag are not considered significant for the purpose of data agreement. The comparison between project and field duplicate sample results should meet RPD criteria for each method listed in Table 4.

Reporting Limits

The reporting limits are the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory conditions. For many analytes, the reporting limit analyte concentration is selected by the laboratory as the lowest non-zero standard in the calibration curve. Sample reporting limits vary based on sample matrix and dilution of the samples during analysis. Reporting limits should be equal to or below the PQLs provided in Table 1 for each method.

Data Qualification

Qualifiers will be applied to QC samples when acceptance criteria are not met and corrective action is not performed or is unsuccessful. These same qualifiers will be applied to the associated sample data, as defined in the following table.

Table 7. Data Qualifiers

Qualifier	Description
J	The analyte was positively identified, the quantitation is an estimation.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit (MDL).
F	The analyte was positively identified but the associated numerical value is below the reporting limit (RL).
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
B	The analyte was found in an associated blank, as well as in the sample.
M	A matrix effect was present.
H	Analysis was performed outside of the recommended holding time.

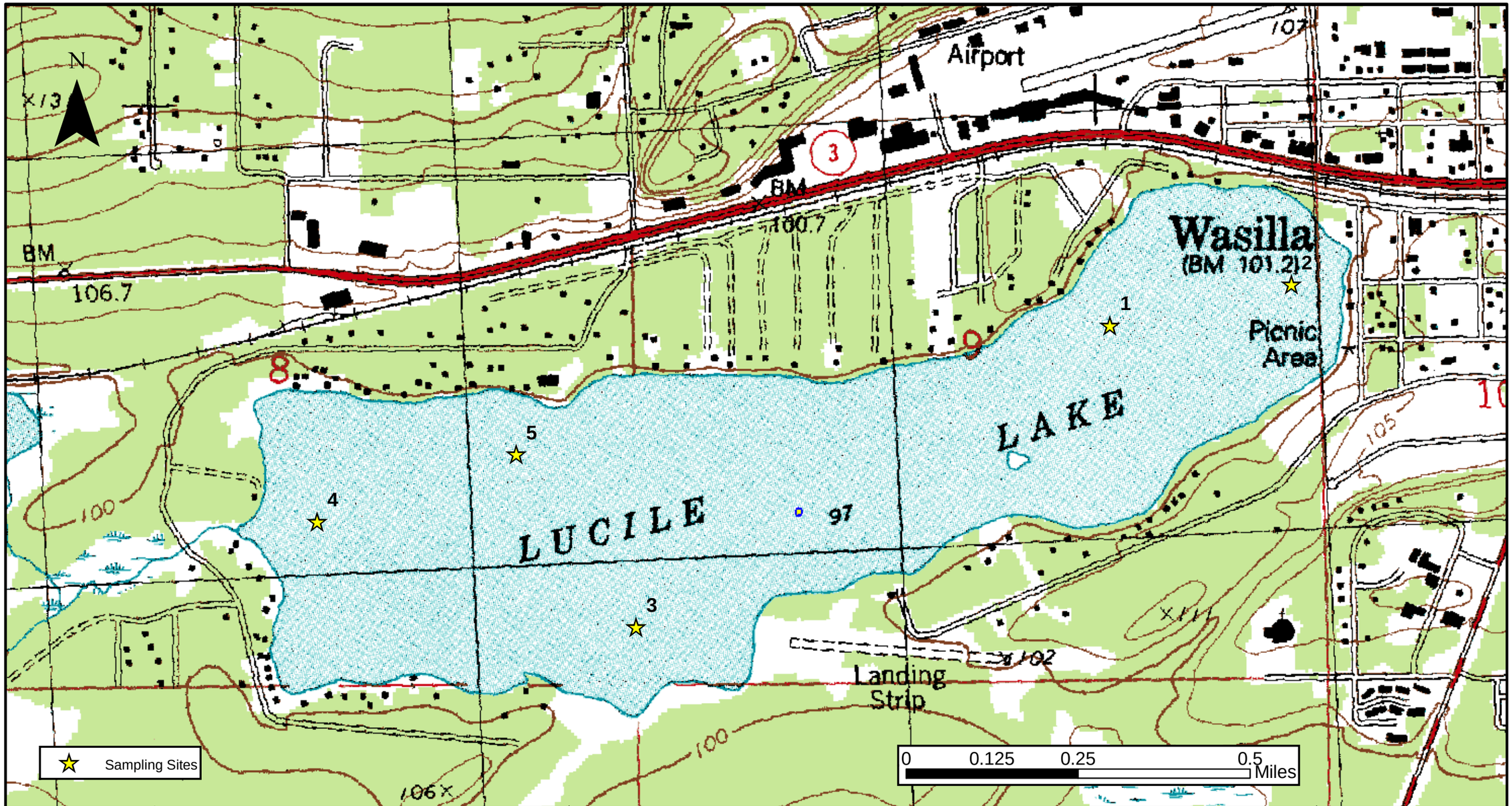
Completeness

Completeness is calculated after the QC data have been evaluated, and the qualifiers have been applied to the sample data. Invalid results, broken or spilled samples, and samples that are unable to be analyzed for other reasons are included in the assessment of completeness. The criteria and calculation to determine completeness are provided in Section A7. If data cannot be qualified to meet completeness goals, OASIS will consult with the ADEC Project Manager to determine if additional sampling should be performed to accomplish data quality objectives.

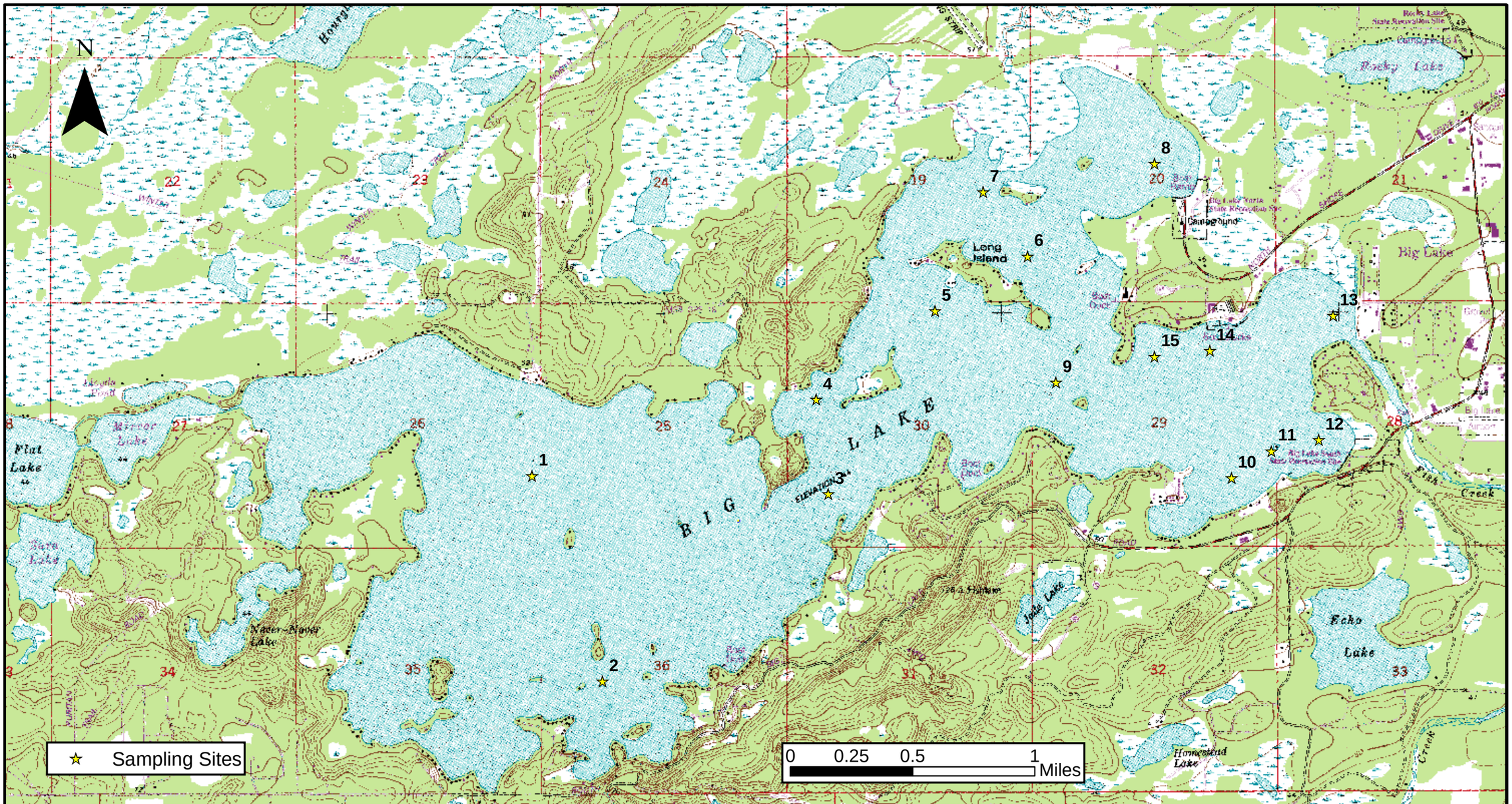
D3. Reconciliation with User Requirements

The Project Manager will review all data deliverables upon receipt from the lab. Laboratory results will be checked for data qualifiers entered by the lab to ensure that sample collection and preservation procedures were adequate and that laboratory analysis procedures met quality assurance objectives. Any outstanding issues will be addressed immediately with the lab and/or sampling staff to ensure that project quality assurance objectives are met.

The Project Manager and Quality Assurance Officer will review and validate the data during the three interim reporting and final reporting stages. If there are any problems with quality sampling and analysis, these issues will be addressed immediately and methods will be modified to ensure that data quality objectives are being met. Modifications to monitoring will require notification to ADEC and subsequent edits to the approved QAPP.



DATE MAY 2004 CHKD P.A. DRAWN B.S. PROJ. NO 14-054	oasis ENVIRONMENTAL	**LAKE LUCILLE AND BIG LAKE WATER QUALITY MONITORING** LAKE LUCILLE SAMPLING SITES Wasilla, Alaska	FIGURE 1



DATE MAY 2004 CHKD P.A. DRAWN B.S. PROJ. NO 14-054	oasis ENVIRONMENTAL	**LAKE LUCILLE AND BIG LAKE WATER QUALITY MONITORING** BIG LAKE SAMPLING SITES Big Lake, Alaska

FIGURE
2

LAKE LUCILLE AND BIG LAKE WATER QUALITY MONITORING
SAMPLE DATA SHEET

SITE INFORMATION		
DATE: / /2004	**SAMPLERS:**	
SAMPLING LOCATION:	**SAMPLE DEPTH:**	
CIRCLE TYPE:	**BACTERIA HYDROCARBONS NUTRIENTS**	
GPS COORDINATES:	N	W
PHOTO # AND DESCRIPTION:		

FIELD MEASUREMENTS: Horiba U-22		
1 METER	**3 METERS**	**5 METERS**
pH:	pH:	pH:
D.O.(Mg/L):	D.O.(Mg/L):	D.O.(Mg/L):
cond. (mS/cm)):	cond. (mS/cm)):	cond. (mS/cm)):
turb. (NTU):	turb. (NTU):	turb. (NTU):
salinity :	salinity :	salinity :
temp. (°C):	temp. (°C):	temp. (°C):
2 METERS	**4 METERS**	**6 METERS**
pH:	pH:	pH:
D.O.(Mg/L):	D.O.(Mg/L):	D.O.(Mg/L):
cond. (mS/cm)):	cond. (mS/cm)):	cond. (mS/cm)):
turb. (NTU):	turb. (NTU):	turb. (NTU):
salinity :	salinity :	salinity :
temp. (°C):	temp. (°C):	temp. (°C):
7 METERS	**9 METERS**	**11 METERS**
pH:	pH:	pH:
D.O.(Mg/L):	D.O.(Mg/L):	D.O.(Mg/L):
cond. (mS/cm)):	cond. (mS/cm)):	cond. (mS/cm)):
turb. (NTU):	turb. (NTU):	turb. (NTU):
salinity :	salinity :	salinity :
temp. (°C):	temp. (°C):	temp. (°C):
8 METERS	**10 METERS**	**12 METERS**
pH:	pH:	pH:
D.O.(Mg/L):	D.O.(Mg/L):	D.O.(Mg/L):
cond. (mS/cm)):	cond. (mS/cm)):	cond. (mS/cm)):
turb. (NTU):	turb. (NTU):	turb. (NTU):
salinity :	salinity :	salinity :
temp. (°C):	temp. (°C):	temp. (°C):
13 METERS	**15 METERS**	**17 METERS**
pH:	pH:	pH:
D.O.(Mg/L):	D.O.(Mg/L):	D.O.(Mg/L):
cond. (mS/cm)):	cond. (mS/cm)):	cond. (mS/cm)):
turb. (NTU):	turb. (NTU):	turb. (NTU):
salinity :	salinity :	salinity :
temp. (°C):	temp. (°C):	temp. (°C):
14 METERS	**16 METERS**	**18 METERS**
pH:	pH:	pH:
D.O.(Mg/L):	D.O.(Mg/L):	D.O.(Mg/L):
cond. (mS/cm)):	cond. (mS/cm)):	cond. (mS/cm)):
turb. (NTU):	turb. (NTU):	turb. (NTU):
salinity :	salinity :	salinity :
temp. (°C):	temp. (°C):	temp. (°C):

LAKE LUCILLE AND BIG LAKE WATER QUALITY MONITORING
SAMPLE DATA SHEET

SECHHI DEPTH TRANSPARENCY			
READING 1:		**READING 3:**	
READING 2:		**READING 4:**	
SAMPLES COLLECTED			
SAMPLE ID:		**TIME:**	
CIRCLE ANALYSES:			
FC	COLOR	DISS PHOS	POC
E. COLI	CHLOROPHYLL A	TKN	ALKALINITY
TAH	TOTAL PHOS	AMMONIA	
PAH	DISS O-PHOS	NITRATE+NITRITE	
COMMENTS (weather, boats in area, etc.):			